TANCHINTONGIA GEN. NOV., A BIZARRE PERMIAN MYALINID BIVALVE FROM WEST MALAYSIA AND JAPAN

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ABSTRACT. Broken pieces of a huge thick-shelled myalinid forming a calcirudite in the Kinta Valley, West Malaysia, show that the live shells rested on spectacular flanges formed by acute bends in the lateral flanks of the valves. Consequently the shells had a large permanent posterior gape, and must therefore have lived below low-tide level. The flanges may have acted like snowshoes to support the animals on the surface of a fine carbonate substrate, or they may have acted as outriggers to prevent overturning. Prominent grooves, formed by the ontogenetic shift in the position of the byssal gape, show that the shells were byssally attached throughout life. Associated ammonoids and fusulines provide an early Permian age for the Malaysian shells; similar fragments occur with Permian fusulines in Japan. *Tanchintongia* was at least as large and as thick-shelled as its cool temperate analogue *Eurydesma*, indicating that these features were not simply temperature controlled in Permian bivalves.

THE opencut tin mines of the Kinta Valley near Kampar, Perak, West Malaysia, have yielded a diverse suite of late Palaeozoic invertebrates (Jones, Gobbett and Kobayashi 1966; Batten 1972). One of the most impressive finds was the discovery of a 3–5 m thick calcirudite (Pl. 45, fig. 8; Pl. 46, fig. 9) formed of the fragmentary remains of a huge Permian bivalve at the H. S. Lee No. 8 Mine (lat. 4° 17′ N., long. 101° 06′ E., topographic map of Malaya, sheet 2N/9, old series; grid reference 909356). Forty-nine pieces of the bivalve were collected from this bed during 1964–1966, and were kindly made available for this study by the Department of Geology, University of Malaya. Type material has been placed in the Sedgwick Museum, Cambridge (SM). Since none of the pieces is a complete shell or even a complete valve, the shell had to be reconstructed from the available fragments.

SYSTEMATIC PALAEONTOLOGY

Class BIVALVIA
Family MYALINIDAE Frech, 1891
Genus TANCHINTONGIA gen. nov.

Type species. Tanchintongia perakensis gen. et sp. nov.

Derivation of name. Named for Tan Chin Tong who collected from the fossil bed.

Diagnosis. Huge, massively thickened, equivalved shell with umbonal carina that bends through about 350° to separate the flattened anterior faces of the valves from their concave postero-lateral flanks. These paired carinae appear to have produced a large triangular posterior shell gape. Beaks widely separated by growth of large triangular cardinal areas; ligament duplivincular, lamellar layers inserted in deep grooves confined to anterior half of cardinal areas. Body cavity ventrally elongated, well separated from beaks by massive umbonal thickening; small byssal opening in

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valve edges at anterior end of body cavity generates symmetrically disposed byssal grooves through growth of shell.

Discussion. The massive shell, terminal beaks, and duplivincular ligament area (Pl. 45, fig. 1; Pl. 46, figs. 4, 8) relate *Tanchintongia* to the Palaeozoic families Myalinidae and Ambonychiidae. The significant morphologic difference between these families is that ambonychiids are equivalved whereas myalinids have a slightly smaller right valve (Pojeta 1966; Newell 1942). The other difference is stratigraphic—ambonychiids dominate in the Early and Middle Palaeozoic to be replaced by myalinids in the Late Palaeozoic. *Tanchintongia* is problematical because it is equivalved (Pl. 45, figs. 2, 5) yet of Late Palaeozoic age. We speculate that it is secondarily equivalved and therefore a myalinid, because stratigraphically suitable ancestors belong to that family. The secondary valve equality would be necessary to maintain equilibrium in the assumed life position. Other myalinids are believed to have rested on their right valves (Newell 1942, p. 21).

Tanchintongia perakensis sp. nov.

Plate 45, figs. 1–8; Plate 46, figs. 1–9; text-figs. 1–2

Holotype. SM G1874 (Pl. 45, figs. 2–5).

Paratypes. SM G1875–1882.

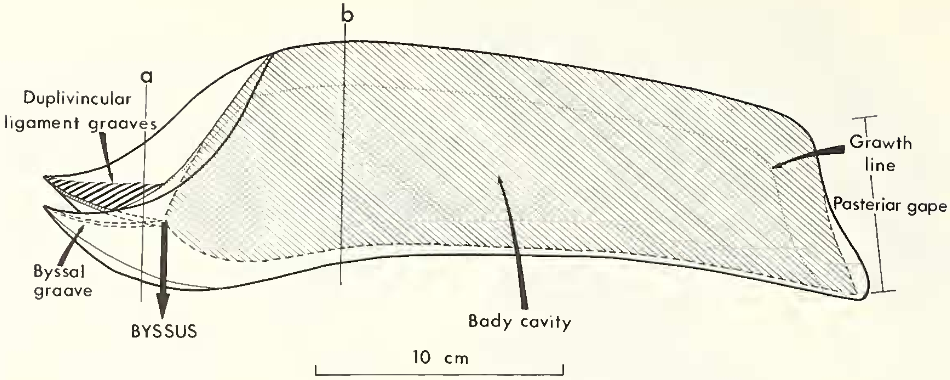
Description. The few articulated fragments in the collection show that the shell was equivalved (Pl. 45, fig. 5; Pl. 46, fig. 7) with large cardinal areas displaying straight (Pl. 45, fig. 1) or sinuous (Pl. 46, figs. 4, 8) duplivincular ligament grooves on their anterior half (text-fig. 1). Well-preserved umbonal fragments have a sharp lateral carina originating at the beak (Pl. 45, fig. 7) and a deep byssal groove on the anteroventral face (Pl. 45, fig. 6). A small umbonal septum is present in one fragment (Pl. 45, fig. 6); there are no hinge teeth. Larger fragments show that the byssal groove extended posteriorly in each valve (Pl. 45, fig. 1; Pl. 46, fig. 4) to the anterior end of the mantle cavity. In large shells this lay as much as 11 cm in a direct line from the beak (Pl. 46, fig. 4). Thus the early formed parts of the valves are secondarily filled by massive deposits of the inner shell layers in an analogous way to the umbonal region of *Eurydesma* (Runnegar 1970). The space occupied by the anterior end of the mantle cavity is well shown by one articulated fragment (Pl. 46, fig. 7).

Behind the posterior ends of the cardinal areas the lateral carinae splayed outwards to produce the impressive flanges on which the shell rested (Pl. 45, figs. 5, 8; Pl. 46,

EXPLANATION OF PLATE 45

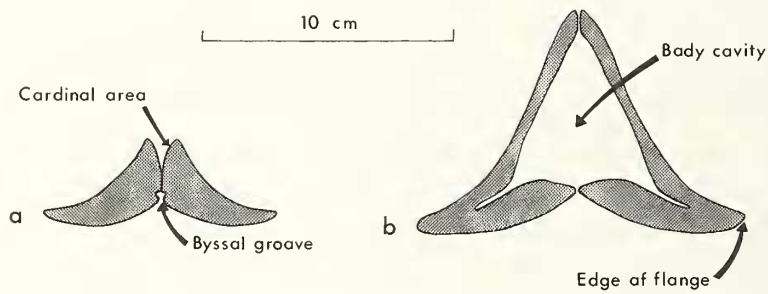
Figs. 1–8. *Tanchintongia perakensis* gen. et sp. nov., Early Permian, H. S. Lee Beds, H. S. Lee No. 8 Mine, Perak, West Malaysia. 1, hinge of left valve, arrow indicates byssal groove, SM G1875, ×0·5. 2–5, anterodorsal, left lateral, oblique, and posterior views of holotype, SM G1874, ×0·33. 6–7, internal and external views of umbonal fragment, SM G1876, ×1. 8, exposure of shell bed in mine; the hammer is 36 cm long; note articulated valves (arrowed).

RUNNEGAR and GOBBETT, *Tanchitongia*



TEXT-FIG. 1. Reconstruction of *Tanchintongia perakensis*. a, b, show lines of sections shown in text-fig. 2.

figs. 1–2; text-fig. 2). It is not clear how these structures terminated posteriorly, but one fragment (Pl. 46, figs. 5–6) shows a cross-section near the posterior end of the mantle cavity. Unless the growth pattern changed abruptly with the onset of sexual maturity, it would be geometrically impossible for the posterior end of the shell to be closed. We assume there was a large permanent triangular gape at the posterior end of the shell (text-fig. 1; Pl. 45, fig. 5). Figures 4 and 5 of Plate 46 are juxtaposed to show how the interior of the right valve may have looked. In this reconstruction the cardinal area disappears in the space between the two figures, and the mantle cavity is largest near the left side of Fig. 5.

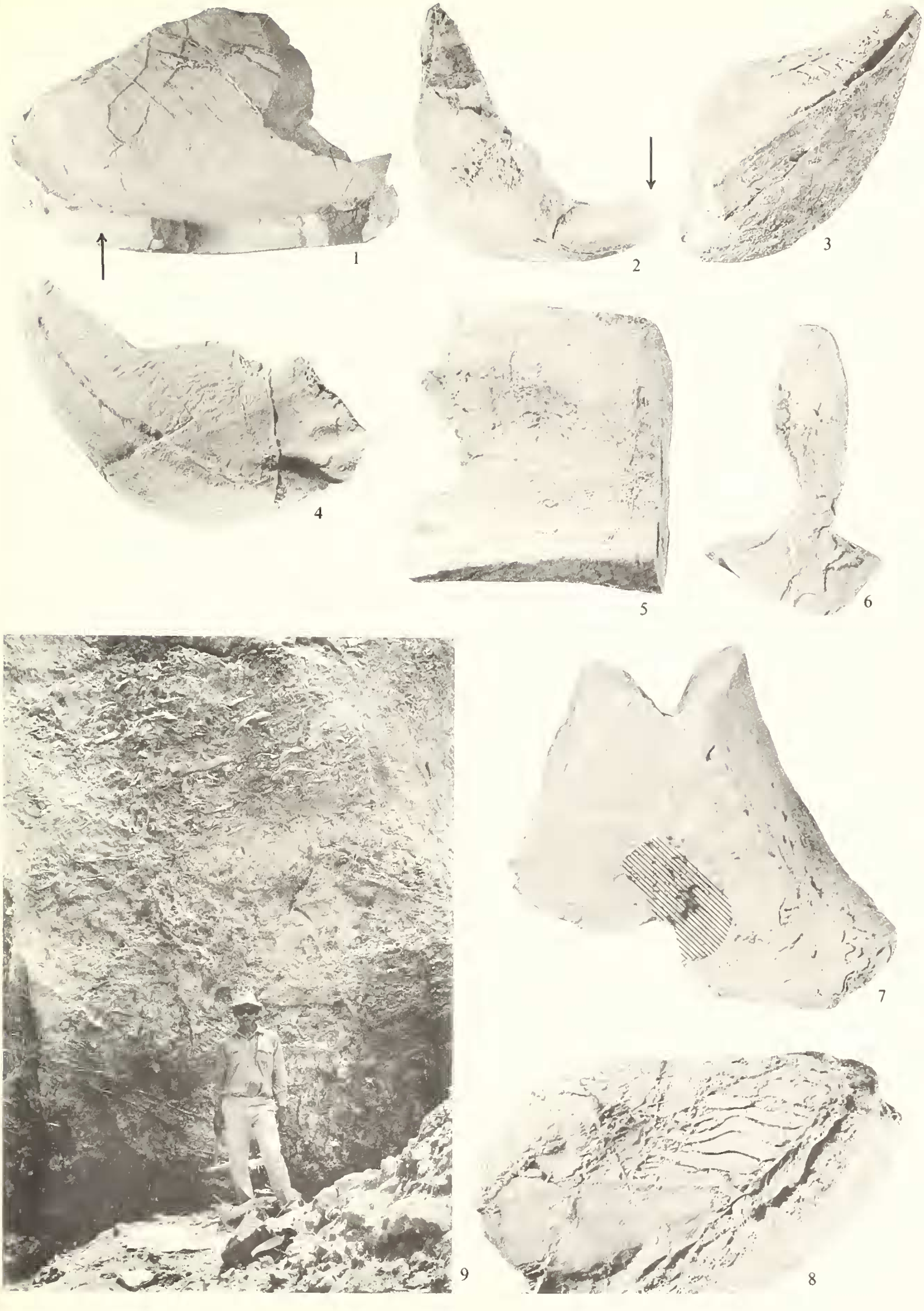


TEXT-FIG. 2. Diagrammatic cross-sections of *Tanchintongia perakensis* along the lines a and b in text-fig. 1.

EXPLANATION OF PLATE 46

Figs. 1–9. *Tanchintongia perakensis* gen. et sp. nov., Early Permian, H. S. Lee Beds, H. S. Lee No. 8 Mine, Perak, West Malaysia. 1–2, left lateral and anterior views of fragment of left valve, arrows indicate edge of flange in both figures, SM G1877, ×0·33. 3, oblique view of umbonal fragment of left valve, SM G1878, ×0·33. 4, umbonal fragment of right valve showing duplivincular ligament area, byssal groove, and beginning of mantle cavity, SM G1879, ×0·33. 5–6, fragment of posterior of right valve, flange broken off lower right of fig. 6, SM G1880, ×0·5. 7, shell fractured across anterior end of mantle cavity (shaded) looking anteriorly, SM G1881, ×0·5. 8, hinge of umbonal fragment of left valve, SM G1882, ×0·5. 9, exposure of shell bed in mine showing large unbroken valves near top of face.

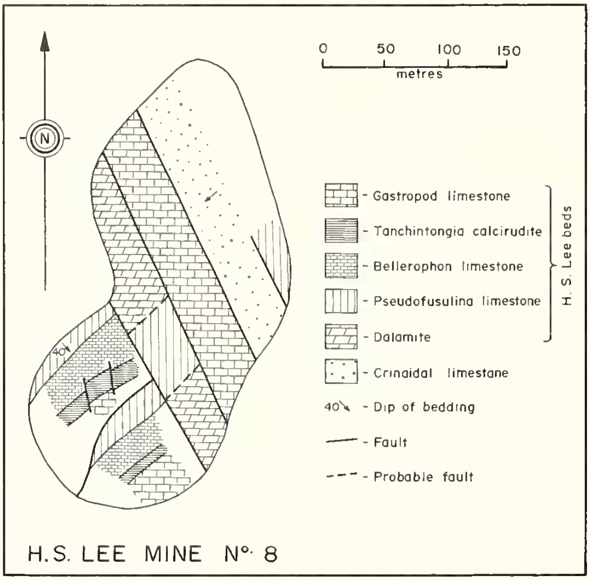
PLATE 46



RUNNEGAR and GOBBETT, *Tanchitongia*

Dimensions. No measurements were taken at the field exposures but estimates from photographs (Pl. 45, fig. 8) suggest that some individuals must have exceeded 35 cm in length. This makes *Tanchintongia* one of the largest Palaeozoic bivalves known (Nicol 1964), being comparable in size to specimens of *Atomodesma* (40 cm), *Megadesmus* (20 cm), *Myonia* (19 cm), and *Eurydesma* (16 cm) from the Permian of eastern Australia. The cardinal area of one specimen (Pl. 46, fig. 4) has a height of 8 cm, and the degree of umbonal thickening is comparable with that seen in *Eurydesma* (5·8 cm, Runnegar 1970) and *Myonia corrugata* (5·5 cm, Runnegar 1967), though it is more difficult to measure. Judging from the field photographs (arrowed shells, Pl. 45, fig. 8), the flanges projected laterally up to 8 or 9 cm from the mantle cavity.

Stratigraphic information. All specimens were collected from a 3–5 m thick calcirudite formed from the valves of *Tanchintongia* (Pl. 45, fig. 8; Pl. 46, fig. 9; text-fig. 3).



TEXT-FIG. 3. Sketch map of H. S. Lee No. 8 Mine, Kinta Valley, Perak, West Malaysia, lat. 4° 17′ N., long. 101° 06′ E.

Scattered fragments occur in the limestone under the calcirudite and are there associated with *Pseudofusulina kraffti* (Schellwien). The few other fossils found with *Tanchintongia* resemble those found in overlying and underlying limestones. These limestones contain a diverse invertebrate fauna including goniatites and gastropods (Jones *et al.* 1966; Batten 1972). *P. kraffti* abounds as detrital grains in limestone about 10 m below the *Tanchintongia* calcirudite. This sequence is called the H. S. Lee Beds (Suntharalingam 1968) and can be correlated with the *Pseudofusulina ambigua* Zone of the Japanese Permian, approximately equivalent to the early Leonardian of North America.

In the latter part of 1966 the H. S. Lee No. 8 Mine was flooded and the exposures are no longer accessible.

Occurrence in Japan. One of us (D. J. G.) noticed worn fragments of *Tanchintongia* in a limestone containing *Pseudofusulina* and *Pseudodoliolina* in the large quarries at Akasaka, Japan. No specimens were available for illustration.

DISCUSSION

The persistence of the byssal gape through all growth stages indicates that *Tanchintongia* lived byssally attached throughout its life. It obviously rested on the large lateral flanges, which together form a virtually flat ventral surface to the shell (arrowed shells, Pl. 45, fig. 8). The most obvious functional explanation of these flanges is that they acted like snowshoes to stop the heavy shell sinking into a soft substrate. This may not be the correct explanation, as they could also have functioned as outriggers to prevent the shell from being overturned. In fact a byssally attached shell of this form could easily have withstood a rigorous high-energy environment. The impressive shell thickening may also have served to weight the shell against turbulent currents.

Tanchintongia must have lived subtidally. It is difficult to believe that an animal with a posteriorly gaping shell could have survived exposure and desiccation at low tide. We conclude that *Tanchintongia* lived gregariously in a sublittoral, probably high-energy environment, attached by a byssus, and weighted and perhaps stabilized by its extraordinary shell construction.

Haile and McElhinny (1972) have palaeomagnetic evidence that the Malay Peninsula lay at a relatively low palaeolatitude in the northern hemisphere in Permo-Carboniferous time. The fusulines and gastropods associated with *Tanchintongia* have definite Tethyan affinities (Batten 1972), as do the remaining bivalves in the collection. The existence of a large thick-shelled bivalve in this fauna indicates that it is unlikely that temperature was the controlling factor in the development of shells of this size and thickness, as comparable shells also occur in the cool-temperate assemblages of Australia.

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